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## USSR TESTS OF TOOL STEEL SUBSTITUTES

Stal', Vol X, No 4, Apr 40

The scarcity of high-speed steel with a high tungsten content has for a long time made it necessary for technicians to try to find a less scarce and a cheaper substitute steel. The many complex tests made at the Stalingrad Tractor Plant of various substitutes (steels EI161, EI172, EI173, EI184, EI216) have shown that none of these is an adequate substitute, and that even under the best conditions, the durability of the tool made from these grades of steel is only 70-80 percent of that of the tool made from the high-speed steel.

The plant then made tests of molybdenum-vanadium and molybdenum-vanadiumtungsten low-alloy steel for the purpose of finding an adequate substitute steel. Tests of steels with the following chemical composition were made:

Steel	C	Mn	Si	Cr	Mo	٧	W
1	1.1	0.40	0.3	4.2	4.0	3.0	-
2	1.2	0.25	0.3	4.2	4.0	4.0	5.0
3	1.3	0.40	0.3	4.2	3.7	4.0	3.5

The steels were smelted in high-frequency electric furnaces and poured into 25-kilogram ingots, forged into bars of various cross section, and then were subjected to isothermal annealing. The optimum temperature for hardening was selected after various tests at 1,220-1,250 degrees for steels of all grades, with tempering at 500-550 degrees.

Cutters made from the molybdenum-vanadium steel proved to be better than cutters of RFI high-speed steel by 8-26 percent in relative speed of cutting. To test the workability of cutters made from molybdenum-vanadium steel, they were given additional tests directly under shop conditions, working parts made of 40 Kh steel with a hardness of 200-229 Nv /Vickers number? Cutters from steel No 2 showed the same workability as cutters from RFI steel. Cutters from steel No 3 showed a workability of 180-200 percent of the workability of cutters made from RFI steel.

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Thus, for durability of the cutters, steels of these grades are not only adequate substitutes for cutters of RFI high-speed steel, but exceed it both in relative speed of cutting (from 8-26 percent) and in durability (from 100-200 percent).

From an economic point of view, molybdenum-vanadium steel has other advantages over RFI: the cost is considerably less, the steel can be produced from domestic raw materials, and the smelting and forging of molybdenum-vanadium high-speed steel does not present as great difficulties as does the smelting and forging of RFI high-tungsten steel. The technology of producing tools from the molybdenum-vanadium steel presents no difficulties.

Stal', Vol V, No 1, Jan 45

Chrome-silicon tool steel 6KhS (EI325) is designed for use in the production of percussion tools: pneumatic hammer chisels, blades for cold and hot cutting of metals, small dies, stamps, and other tools which demand considerable hardness with moderate toughness. The chemical composition of the steel is as follows: 0.60-0.70 percent C; 0.60-100 percent Si; 0.40 percent Mn; 1.0-1.30 percent Cr; 0.30 percent Ni; 0.030 percent S; 0.030 percent P.

Comparison tests were made of 6KhS and 4KhVS, 5KhVS, 5KhNM, and U8A to define the possibility of replacing the latter four grades, to save on scarce alloys, and to increase productivity at the expense of a small increase in steel price by using grade 6KhS instead of U8A.

The tests showed that the hardness of 6KhS after hardening and tempering up to 200 degrees is higher than in 5KhVS and 4KhVS; the hardness after tempering above 300 degrees is lower than 5KhVS, but higher than 4KhVS; temporary resistance at temperatures up to 300 degrees is higher than 4KhVS, 5KhVS, and 5KhNM, but is lower at a temperature above 400 degrees.

In the production of chisels, small dies. and stamps, 6KhS can be substituted for U8A, 4KhVS, 5KhVS, 6KhVS, and 5KhNM. For chisels, this steel is more durable than U8A, is better than 5KhNM for dies, and better than 4KhVS for stamps. The substitution of 6KhS for 4KhVS, 5KhVS. and 6KhVS provides a saving in tungsten, and at the same time provides good durability of chisels, stamps, and dies (in cold or semihot working). Steel 6KhS is used by a number of plants for production of chisels, blades, and stamps, but its use in production of dies should be more widely tested.

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